

PREASSESSMENT EVALUATION OF INJURY TO ROCKY INTERTIDAL COMMUNITIES

Rocky coasts encompass many types and sizes of substrates. Included in this general class are:

- Vertical bedrock cliffs, such as along fjords.
- Wide, rocky ledges which may be strewn with boulders.
- Rocky, rubble slopes which are formed by passive accumulation of sand to boulder-sized on bedrock slopes.

There can be wide variations in the width of the intertidal zone and the degree of "permeability" of the rocky substrate. Since oil seldom strands on exposed rocky shorelines, emphasis is placed on sheltered intertidal rocky habitats. Because of the low wave energy, there is little sorting of sediments, and there can be a jumbled mix of grain sizes, from boulders to clay overlying the bedrock. This poorly sorted mixture usually does not allow deep penetration of oil into the subsurface. However, determination of the "surface" on a shoreline with boulder- and cobble-sized rubble layer overlying an irregular bedrock platform with patches of muddy sand and granules is complex. Detailed information regarding the effect of oil on the three types of sheltered rocky coasts is summarized below.

Summary of Known Impacts from Oil Spills

VERTICAL ROCKY SHORES

- Oil will adhere readily to the rough rocky surface, particularly along the high tide line, form distinct oil band.
- The lower half of the rock face usually stays wet enough to prevent oil from adhering remaining.
- Heavy oils and weathered oils can coat the upper zone with little impacts to the rich biologic communities of the lower zone.
- Fresh oil and light refined products have high acute toxicities which can affect attached organisms after even short exposures.

ROCKY LEDGES

- Oil can adhere readily to the rough rocky surface, particularly along the high tide line, for distinct oil bands.
- If a beach is present, the oil will penetrate the sediments, with long-term persistence likely.
- Fractures in the bedrock surface are sites of oil pooling and persistence.
- Even for wide ledges, the lower intertidal zone usually stays wet enough to prevent oil adhering to the rock surface.
- Heavy oils and weathered oils can persist on the lower intertidal zone by penetrating the sediments.
- Fresh oil and light refined products have high acute toxicities which can affect attached organisms after even short exposures.

RUBBLE SLOPES

- Oil can adhere readily to the rough rocky surface, particularly along the high tide line, for distinct oil bands.
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Oil will penetrate into the crevices formed by the surface rubble and pool at the contact of rubble and the surface.

- Oil can form pools and eventually pavements under heavy oiling.
- Oil can penetrate deeply into loosely packed rubble, causing long-term contamination of subsurface sediments.

Methods for Assessment of Impact to Rocky Intertidal Communities

Successful programs require considerable rigor and thought in development of the sampling design. Study sites have to be stratified by degree of oiling, habitat type including degree of exposure to physical processes, and tidal elevation. There should be a minimum of three true replicate sites per unique combination of conditions, including reference (unoiiled) sites. Only randomly selected sites will allow inference of the results to other oiled sites, thus the sampling design should include randomized but rejectable site selection within each strata.

Once the sites have been selected, observations are recorded within each site along transects or at quadrats. [Lees and Houghton \(1995\)](#) recommend 5-20 replicate quadrats per tidal elevation, with more quadrats at heterogeneous sites and fewer at homogenous sites. These horizontal transects are centered at the level of maximum development for dominant biological assemblages at each tidal level. Each sample location along the transect is usually a 0.25 square meter quadrat which is initially randomly located then permanently marked, to allow repeated sampling of the same marked location in subsequent surveys (to reduce variability). Within each quadrat, counts or estimates are made of the parameters listed in Table 7. Methods for collecting these data are described in [Baker and Wolff \(1987\)](#), [Moore and McLaughlin \(1978\)](#), and [Zeh et al. \(1981\)](#). Photographs of each quadrat should be taken, for documentation and backup in case additional measurements are needed.

TABLE 7. Parameters for quantification of oil spill effects on rocky intertidal communities.

Species abundance and density

Percent cover by dominant species

Percent live cover, by species

Percent dead cover, by species

Percent bare ground

Reproductive condition

Application to Injury Quantification

Most intertidal communities provide service flows to other natural resources, in terms of habitat and food, as well as recreational and educational value to humans. In some areas, they also provide food for humans. Thus, injury should be measured in terms of a reduction from baseline in the quantity,

quality, and composition of the dominant and key communities at the affected sites. In addition, the time to recovery for each strata should be estimated.